
Report

Final Draft Corrective Measures Proposal

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EMD Chemicals Inc.

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CH2MHILL
One South Main Street
Suite 1100
Dayton, Ohio 45402

Report

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Submitted to
**U.S. Environmental
Protection Agency**

June 2006
Revision 1 – November 3, 2006

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Draft Corrective Measures Proposal

1.0 Introduction

EMD Chemicals Inc. (EMD) entered into a Voluntary Corrective Action Agreement (VCAA) with U.S.EPA in September 2004 to expedite completion of RCRA Corrective Actions at their Cincinnati, Ohio facility. Working collaboratively with U.S.EPA under the VCAA, EMD has completed the site investigation, developed a conceptual model of site conditions, demonstrated that both Environmental Indicators (EI's), *Current Human Exposures Under Control - Environmental Indicators RCRIS Code (CA725)* and the *Migration of Contaminated Groundwater Under Control - Environmental Indicators RCRIS Code (CA750)* have been met, and characterized the potential risk associated with site conditions. Pursuant to Section V-D-1 of the VCAA Agreement, EMD has prepared this *Corrective Measures Proposal (CMP)* to outline corrective measures which will continue to protect human health and the environment from unacceptable risks associated with releases of hazardous waste and hazardous constituents at or from the Facility.

This *Draft CMP* presents information summarized from the following documents which are referenced by their respective numbers through this report:

- (1) *Remedial Investigation* (TPF, 1996)
- (2) *Feasibility Study Report* (TPF, 2000)
- (3) *Feasibility Study* (Ohio EPA, 2004)
- (4) *Draft Conceptual Model of Current Conditions* (CH2M HILL, 2005)
- (5) *Conceptual Model of Current Conditions* (CH2M HILL, 2006c)
- (6) *Human Health Risk Assessment Addendum* (CH2M HILL, 2006a)
- (7) *Technical Memorandum – Update for the Human Health Risk Assessment Addendum of Off-Site Soils* (CH2M HILL, 2006b) (included as Appendix B to the *Human Health Risk Assessment Addendum*)
- (8) *Current Human Exposures Under Control - RCRA Corrective Action Environmental Indicator (EI) RCRIS Code CA725* (Ohio EPA, 2002)
- (9) *Draft Migration of Contaminated Groundwater Under Control – RCRA Corrective Action Environmental Indicator (EI) RCRIS Code CA750* (CH2M HILL, 2005)
- (10) *Conceptual Agreement for Corrective Measures Plan – EMD Chemicals Inc. Cincinnati Facility* (EMD, 2006)

Public participation has occurred per the VCAA, and EMD has provided previous notification to the public of relevant activities performed under Ohio EPA's lead. Copies of all applicable reports have been made available at the Cincinnati Public Library (Norwood Branch) in Cincinnati, Ohio for the public to review.

This *Draft CMP* has been structured to provide all of the information necessary for U.S.EPA to make a final remedy decision and for use in preparing a Statement of Basis. The *CMP* is organized as follows:

- Section 1.0 - Introduces the site, brief background, and purpose of document.
- Section 2.0 - Provides an overview of corrective action objectives, agreed to performance standards, and the proposed corrective measures to address objectives/standards.
- Section 3.0 - Presents the facility background, overview of the site conceptual model, current and reasonably foreseeable future land use, and interim measures performed to date.
- Section 4.0 - Presents an overview of the site conceptual model, contaminants of concern, and a summary of facility risks to be addressed by the proposed corrective measures.
- Section 5.0 - Presents a brief overview of the remedy alternatives assessed in previous feasibility studies.
- Section 6.0 - Presents a summary of the scope of corrective action and the proposed components of corrective measures.
- Section 7.0 - Presents an evaluation of the proposed components of corrective measures.
- Section 8.0 - Discusses public participation in the corrective measure process.
- Section 9.0 - References

2.0 Overview of Corrective Action Objectives and Proposed Corrective Measures

Consistent with the purpose of the VCAA, as discussed with U.S.EPA on March 10, 2006, and as summarized in the *Conceptual Agreement for Corrective Measures Plan* (10), EMD and U.S.EPA have agreed on the following Corrective Action Objectives (CAOs) for the Cincinnati Facility:

- Maintain protective conditions
- Implement safe, technically and economically feasible corrective measures
- Effective and sustainable long-term operation, maintenance & monitoring
- Reduce environmental liability
- Minimal disruption of facility operations

EMD proposes the following corrective measures to meet these CAOs:

- Removal of off-site waste and consolidation with on-site waste
- Containment and management of on-site waste in-place
- Containment of contaminated groundwater
- Institutional controls

The following Performance Standards are being proposed to demonstrate that the corrective measures are functioning as necessary to meet the CAOs. These Performance Standards were discussed with, and conceptually agreed to by U.S.EPA during the March 10, 2006 meeting (10):

On-Site Performance Standards

- Effectiveness of containment (waste and contaminated groundwater) will be demonstrated through the following observations:
 - Stable surface conditions maintained in areas indicative of subsidence.
 - Concentration levels of contaminants in groundwater do not increase and will likely decrease.
- Effectiveness of engineering controls demonstrated through inspection of the following:
 - Site cover integrity monitored for cracks (structures) or erosion (soil cover).
 - Site fencing effectiveness as an access control.
- Demonstration that appropriate institutional controls are in place:
 - Deed restriction to industrial land use is filed.
 - Site operational practices and controls implemented to protect workers.

Off-Site Performance Standards

- Visible and accessible wastes associated with on-site activities (consisting of concrete demolition debris, broken or whole bottles containing off-spec chemicals) will be removed.
- Off-site soils identified as being impacted through visual or screening level observations (e.g. photo ionization detector) in the vicinity of the existing off-site sump system will be removed to the extent practical during construction. Excavations will be limited to physical restraints (road, railroad bridge, etc.). Confirmatory soil sampling will not be necessary or conducted.
- Cleanup standards for off-site groundwater will be risk-based levels for COCs associated with EMD facility:
 - Standards to be calculated based on appropriate and currently identified exposure scenarios for current and reasonably anticipated future land use (a construction worker entering an excavation in the affected area of the transportation corridor).
 - MCLs are not applicable because perched groundwater is not a drinking water source and therefore ingestion is not a relevant exposure pathway.
- Point of compliance is the property boundary.

The corrective measures will be designed and implemented to meet the Performance Standards identified above. At this time EMD anticipates the measures to consist of the following elements:

- An on-site groundwater collection trench and low permeability containment wall along the southern property boundary to intercept groundwater containing COCs to ensure groundwater migrating off site potentially containing COCs continues to remain below risk based levels; this will include the construction of new collection sump on EMD's property to replace and upgrade the existing off-site sump and the removal of off-site waste/placement of waste in the on-site portion of the West Ravine;
- A new surface cover system over a portion of the West Ravine and modifications to the storm water management system to reduce surface water infiltration into the West Ravine;
- Continued operation of the existing French Drain groundwater collection system to prevent the migration of COCs in groundwater to the eastern property boundary;
- Institutional and engineering controls to eliminate potential and future human health exposure pathways; and,
- Long term monitoring to assess the performance of the corrective measures.

In addition to these corrective measures, EMD has elected to perform the following enhancements, beyond measures necessary to achieve protective site conditions. These additional measures have been designed to provide contaminant mass removal:

- In-situ remediation of impacted soils located in the former tank farm area; and,
- Limited excavation of impacted soils in the vicinity of the existing off-site sump system.

CAOs and Performance Standards will be met by the proposed corrective measures as follows:

- Prevent exposure to on-site impacted soils or groundwater during excavation activities through use of EMD facility engineering controls;
- Prevent future exposure to on-site impacted soils or groundwater during excavation activities with institutional controls that will run with the land (deed restrictions);
- Prevent on-site exposure to indoor air vapors with EMD facility engineering controls;
- Continue to prevent on-site contaminated groundwater from migrating beneath the eastern property boundary;
- Continue to prevent on-site storm water from coming into contact with buried waste;
- Ensure that impacted off-site groundwater south of the site that contains contaminants of concern below risk based goals as defined in the human health risk assessment, remains below risk based goals through containment of impacted groundwater along the southern property boundary and periodic monitoring to ensure effectiveness; and,
- Remove all off-site visible waste (debris) and a limited amount of contaminated soil in the vicinity of the existing off-site sump system (readily accessible and removal action non-detrimental to existing structures).

3.0 Facility Background

Facility background information, summarized here, can be found in the *RI/FS* (1, 2, and 3) and in the *CMCC* (5).

3.1 Site Description

The EMD Chemicals Inc. Cincinnati, Ohio site (EMD) is located at 2909 Highland Avenue, Cincinnati, Ohio near the interchange of US Interstate 71, Ohio State Route 562, and a Norfolk Southern (NS) railroad line (see **Figure 1 – Site Vicinity Map**). The western 6.62 acres of the site fall within Norwood city limits and the eastern 2.38 acres fall within Cincinnati city limits (1). The site is an active facility with the majority of the area being covered with asphalt, gravel, or concrete. A fence surrounds the property and 24-hour, active security is maintained to limit access to authorized personnel. Along the southwestern portion of the site, a 50-foot wide tree and grass covered hillside drops in elevation from the site to Ohio Department of Transportation (ODOT) and NS right of ways. The topography of the site previously included two ravines, the West and East Ravines, associated with the Duck Creek drainage system. Except for the mouth of the West Ravine, the two ravines have been filled to grade from approximately 1952 to 1971. The mouth of the West Ravine consists of steep slopes carved in fill material that is vegetated with trees and brush. A drainage pipe at the mouth of the West Ravine allows perched groundwater to drain from the filled portions of the ravine. This drainage is intercepted by Sump 562.

3.2 Land Use

The property is located in a mixed commercial/industrial setting northwest of the intersection of Interstate 71 and State Route 562, west of a Norfolk Southern railroad, and east of various industrial and commercial properties. Several residential houses are located along Highland Avenue northwest of the site, and there are some residential houses to the southwest. Highland Avenue aligned east to west, bisects the EMD facility (see **Figure 1**).

The *CMCC* (5) indicates that the impacts resulting from historical facility operations do not encroach upon residential or neighboring industrial areas. The *Migration of Contaminated Groundwater Under Control Environmental Indicator RCRIS Code (CA750)*(9) demonstrated that dissolved concentrations of COCs terminate at the 96-inch storm sewer immediately east of the site and the Duck Creek Box Culvert located in the ODOT right of way immediately south of the site (see **Figure 2 – Dissolved Contaminant Plumes**). The land use as a transportation corridor is expected to remain the same for the foreseeable future.

3.3 Site Background

The EMD site has been used for the industrial manufacturing, storage, and distribution of organic and inorganic chemicals since the late 1940's (5). EMD, as their previous entity of EM Science (a subsidiary of EM Industries, Inc.), purchased the property in 1977 unaware of soil or groundwater impacts that previous owners had created (e.g. the subsequently discovered buried waste). Chemical discharges from process buildings and underground pipes are known to have occurred between the 1950's and 1970's (1).

The EMD property north of Highland Avenue, purchased in 1994, does not exhibit evidence of impacts from historical operations (1).

The West Ravine was a 25-foot deep depression that previously cut across the EMD property (see **Figure 3 – Facility Map**). From approximately 1952 to 1971, the West Ravine was backfilled with soils, construction debris, and off-spec chemical waste containers. The West Ravine was eventually filled in and brought to grade by the previous owner to increase the usable area. From the 1950's to the 1970's chemicals were buried in the West Ravine (1).

Additionally, the *Remedial Investigation* (1) identified two other major areas where historical releases occurred: the area immediately south of Building 10 and the area immediately southeast of Building 4 inclusive of the former tank farm. Both of these impacted areas were likely the result of drainage from sewer lines, drains, and process pipes that eventually migrated to the West Ravine. There are also secondary, localized areas of soil contamination which with the area south of Building 10 will be dealt with collectively in this CMP as on-site impacts. Details related to previous investigations of releases can be found in the CMCC (5) and *Remedial Investigation* (1).

Chemical processes identified in the *Remedial Investigation* (1) that have occurred at this site include the synthesis, purification, formulation, repackaging, and storage of organic and inorganic solvents, liquids, powders, salts, and acids. Historical operations predominantly occurred in a cluster of buildings in the central portion of the EMD property south of Highland Avenue (Buildings 3, 9, 10, 11, and 19 on **Figure 3**) and near the southern boundary at Building 4. A former underground storage tank (UST) tank farm, located in the filled portion of the West Ravine immediately southeast of Building 4, was used for storing organic solvents including 1,4-dioxane (2). The footprint of the former tank farm is located primarily on the west slope of the West Ravine. COCs were likely released from this area due to overfilling of the USTs or from improper chemical handling in the Building 4 area. It is thought that this source contributed to the currently observed concentrations of dissolved 1, 4-dioxane in groundwater and soil in this area.

In summary, the majority of the environmental impacts as identified in the above investigations took place over 25 years ago and include impacted soils and groundwater in the vicinity of the former tank farm (inclusive of the Building 4 area), the area south of Building 10, and buried waste in the West Ravine. The soils south of Building 10 and the secondary on-site soil contamination will be addressed collectively in this CMP as on-site impacts. The COCs for this site, as related to risk assessment, are VOCs of which 1, 4-dioxane is the most mobile.

3.4 Hydrogeological Setting and Contaminant of Concern

3.4.1 Hydrogeological Setting

The geology in the vicinity of the site generally consists of fill underlain by approximately 70 feet of discontinuous sand and gravel within predominantly glacial and lacustrine silt and clay (1). These discontinuous units include the fill, upper till, upper sand, and lacustrine units on **Figure 4 (Perched Groundwater Units)** and contain sparse amounts of groundwater. The groundwater found within these units is considered perched as it is separated from a regional aquifer, the Norwood Trough Aquifer described below, by a series of 10 to 30 feet of unsaturated, low permeability confining layers that act as aquitards. The perched groundwater generally flows to the southeast and is not a plausible source of potable water. Recent calculations have estimated that the flow through the West Ravine units (fill, lacustrine, and upper till) to average 0.5 gallons per minute (gpm) cumulatively, with overall flow rates less than 0.2 feet per day (5). Groundwater gradients range from 0.01 feet/foot (ft/ft) on-site to 0.13 ft/ft near the EMD south property boundary and across the French Drain. The *CMCC* (5) contains a more detailed description of groundwater flow conditions.

The Norwood Trough Aquifer has an upper layer of approximately 85 feet of partially cemented sand and gravel deposits that exhibit low permeability and act as a confining zone (5). Below the confining zone, a confined aquifer, consisting of approximately 75 feet of saturated sand and gravel is present. Subsurface investigations at the site have demonstrated that there is no connection between the perched groundwater and the Norwood Trough Aquifer beneath the site (1). See **Figure 5 (Cross Section Y-Y')** for a stratigraphic cross-section following along the longitudinal axis of the West Ravine.

The nearest surface water is Duck Creek which is a stream approximately 600 feet southeast of the site (see **Figure 1**). Off-site groundwater flow from the fill, lacustrine, and lower clay units eventually drains into the box culvert backfill created for Duck Creek southeast of the site. A more detailed discussion of the site and regional hydrogeology can be found in the *Remedial Investigation* (1) and the *CMCC* (5).

3.4.2 Contaminants of Concern

Initial Site sampling during the early stages of the RI included the list of analytes from 40 CFR 264 (US Code of Federal Regulations), Appendix IX and radionuclides (1). Initial RI investigations focused on sampling the SWMUs/ AOCs and the West Ravine area to determine the site-specific parameter list (SSPL). Through assessment of the analytes actually detected at the Site and site-specific knowledge (i.e., chemicals either not used or not known to be present at the Site), the list of constituents to be included in the SSPL for additional assessment was limited to those requiring further assessment in the later stages of the RI. Details of the development of the SSPL are presented in the *CMCC* (5).

Dissolved COCs related to the site, VOCs such as BTEX (benzene, toluene, ethylbenzene, and xylenes), chlorinated VOCs, and 1,4-dioxane, are largely observed in the perched groundwater system (5), specifically the fill, upper till, upper sand, lacustrine unit, and the upper portion of the lower clay as shown on **Figure 4**. The dissolved COCs in the perched groundwater are limited to approximately two-thirds of the site and a down-gradient, off-site area to the

southeast (see **Figure 2**), and dissolved plumes are found to be stable to decreasing. The CMCC (5) reviews the discussion on how natural attenuation of chlorinated VOCs in the perched groundwater is occurring, and reducing conditions found across the site.

The COCs have not migrated significantly in soils, and most impacts seen at the mouth of the West Ravine are likely the result of earlier discharges from a 16-inch clay pipe and subsequent overland flow before that pipe was terminated. The 1,4-dioxane concentrations indicate the largest aerial extent of the dissolved concentrations. This is due to the properties of that chemical which has a low affinity to sorb to soil and travels at nearly the rate of groundwater, thus acting like a dye tracer. Extents of COC and additional discussion on fate and transport processes can be found in the CMCC (5).

Surface water samples have been collected from Duck Creek at up and downstream locations relative to the facility each quarter since the third quarter of 2004. Dissolved COCs have not been observed above maximum contaminant levels (MCLs) in any of the quarterly surface water samples. In addition, supplemental investigations requested by the U.S.EPA and performed in October 2005 demonstrated that COCs were not present on the south side of the Duck Creek box culvert or in the backfill at the terminus of the Duck Creek box culvert (see **Section 5.1** and **5.2**).

3.5 Interim Measures

Active interim measures, described below, were installed throughout the 1980s and 1990s to ensure that site conditions were protective while conditions and corrective measures were being evaluated. Interim measure details are presented in the CMCC (5). Some interim measures will no longer be needed once the final remedy is in place, and others will be incorporated into the final remedy.

Interim Measures to be incorporated into the Remedy:

- A groundwater collection trench (i.e., French Drain) designed to intercept impacted groundwater migrating to the east and southeast of the West Ravine area through the Upper Sand Unit.
- Extraction Well P6A designed to control the hydraulic gradients east of the French Drain (backup system for the French Drain to cut off impacted groundwater migrating off-site to the east).

Interim Measures to be replaced by the Remedy:

- Sump 562 installed at the mouth of the West Ravine (see **Figure 3**) to intercept and collect storm water and seepage from the West Ravine fill.
- The current storm water management system designed to prevent storm water from contacting buried waste, and to allow storm water (waters not impacted by facility operations) to bypass soils and waste in the mouth of the West Ravine (1).

4.0 Summary of Facility Risks

4.1 Potential Human Health Risks

EMD has evaluated potential human health risks associated with the Facility based on industrial land use for on-site conditions. Off-site conditions were evaluated assuming that use of adjacent downgradient properties (ODOT/NS transportation corridor) would remain the same. These risk evaluations presented in the *Remedial Investigation* (1) and the *Human Health Risk Assessment (HHRA) Addendum* (6) reached the following conclusions:

- On-site exposures resulting in risks above U.S.EPA risk reduction goals were found to be associated with the following scenarios:
 - Workers potentially exposed to concentrations in indoor air above U.S.EPA risk reduction goals¹ due to vapors potentially migrating from soils containing high concentrations of VOCs.
 - Construction workers potentially exposed through inhalation of vapors, and through direct contact with soils or waste (resulting in soil ingestion and dermal contact) containing high concentrations of VOCs West Ravine.
- The only identified, complete off-site exposure pathways based on 1996 data was associated with a construction worker scenario in a limited area at the base of the West Ravine (6). In 2006, revised risk calculations performed on soil sample data results from a May 2006 sampling effort. This was accomplished to determine whether current conditions indicate that risks due to COCs have decreased to be at or below risk based levels (7).
- Site contamination does not pose a significant risk to identified or anticipated on-site ecology and no complete or significant ecological receptor exposure pathways were observed on or off-site in relevant areas.

The numerical results for the exposure scenarios considered likely to have complete exposure pathways at the site are summarized in **Table 1 (Summary Results for Constituents of Potential Concern Contributing the Majority of Risk for Potentially Complete Exposure Scenarios)**. The risks estimates presented in **Table 1** are driven principally by observed concentrations of VOCs in soil and groundwater. Additional information on the risk assessment results is summarized in the following paragraphs and is presented in the *HHRA Addendum* (6).

¹ The risk reduction goals for the site are to achieve a target cancer risk within the range of 10^{-6} to 10^{-4} , and to achieve a target non-cancer level of exposure corresponding to a Hazard Index (HI) of one.

4.1.1 Indoor Air Risks

The original *Baseline Risk Assessment* (1) evaluated a range of potential exposure scenarios for the chemicals detected in soil and groundwater at the site. In many cases, these scenarios involved hypothetical future land uses (such as residential land use) and exposure pathways that are highly unlikely to be complete. For the pathways and scenarios likely to be complete, the baseline risk assessment identified potential exposures higher than a noncancer hazard index of one associated with exposures of construction workers. The *HHRA Addendum* (6) updated the baseline risk assessment to include evaluation of risks on-site EMD workers potentially from indoor vapor intrusion.

The excess lifetime cancer risk (ELCR) associated with vapor intrusion of carcinogenic COPCs in soil was higher than 1×10^{-4} under a reasonable maximum exposure (RME) exposure scenario, and a noncancer Hazard Index (HI) slightly greater than one. The key assumption for the RME scenario is that an individual is located continuously in a building that is situated over concentrations in both soil and groundwater that represent the 95% upper confidence level (UCL) on the average across the site. This is a conservative estimate of the potential risks, because it is unlikely that the contaminant distribution in soil would achieve these high exposure levels.

It is anticipated that potential vapor intrusion pathways would not affect the ability of EMD to manage occupational health and safety associated with VOCs handled at the facility. Potential inhalation exposures to these VOCs are well below occupational exposure levels. Potential exposure to VOCs stored and handled at the facility are managed through normal operating practices, including engineering controls, industrial hygiene surveillance, and a hazard communication program all of which are consistent with Occupational Health and Safety Administration standards for industrial operations. Therefore, it is anticipated that these practices also would address potential exposures to VOCs potentially from vapor intrusion.

4.1.2 Construction Worker Exposure Risk

The ELCRs for construction workers either in on- or off-site locations fall within the risk reduction range of 1×10^{-6} to 1×10^{-4} , and are not associated with a significant noncancer health risk.

The *Human Health Risk Assessment Addendum, EMD Chemicals Inc.* (HHRA Addendum, CH2M HILL 2005) identified the potential for excess noncancer health effects to construction workers excavating in off-site soil in the area of the mouth of the West Ravine. Based on investigations to date, the soils located in the mouth of the West Ravine contain the highest concentrations of chemicals of concern (COCs) in off-site soils impacted as a result of historical operations conducted prior to EMD site ownership. The noncancer risks were driven primarily by elevated concentrations of carbon tetrachloride detected in soil samples collected by EMD Chemicals Inc. (EMD) from two test borings in 1997. As part of EMD's corrective measures evaluation, these locations were re-sampled for EMD's site-specific target analyte list (TAL) of volatile organic compounds in May 2006 and updated risks were estimated for construction worker exposure to off-site soils.

The resampling in May 2006 of two locations in off-site soils at the mouth of the West Ravine showed substantial decreases in concentrations of carbon tetrachloride in soil. This resulted in corresponding reductions in estimated non-cancer risks to construction workers. Concentrations of other constituents (primarily 1,2-dichloroethane and vinyl chloride) increased in these soil samples. The increased concentrations might be due to a combination of factors, including the formation of degradation products and variability in sampling results. Based on consideration of the conclusions presented in the CMCC that indicate no off-site sources exist, current monitoring data that indicate that concentrations of COCs in groundwater are stable to decreasing, and the presence of interim measures and future proposed corrective measures that will control any potential future releases from the West Ravine by both containing West Ravine waste and intercepting groundwater flowing through the West Ravine area that contains COCs at concentrations above risk based levels, it is unlikely that concentrations of VOCs in off-site soils will increase over time.

The estimated non-cancer hazard index for liver effects in construction workers decreased substantially based on the new sampling results; at the same time, the estimated non-cancer hazard index for kidney effects increased slightly. These changes correspond to the relative decreases in concentrations of some VOCs (carbon tetrachloride) and increases in others (1,2-dichloroethane). Overall, the highest hazard index was 1.1, based on kidney effects from potential exposure to 1,2-dichloroethane.

The key assumption for the RME scenario is that an on-site construction worker is always exposed to the 95% UCL on the average concentrations both in soil and groundwater, and that the worker is always located at the mouth of the West Ravine. Use of the 95% UCL on the average provides a very conservative indication of potential human health risks. Since risks under the RME case do not substantially exceed a noncancer HI of 1.0, it is concluded that soil and groundwater contaminants on-site do not pose significant noncancer health risks to construction workers. However, the potential risk will be actively managed during corrective measures through cover placement and institutional controls, and engineering controls consistent with best management practices.

The HHRA Addendum, inclusive of all modifications discussed herein, was accepted without additional comment by the USEPA on October 25, 2006.

4.2 Off-Site Groundwater

Previously completed reports accepted by U.S.EPA have shown that groundwater migration is under control (9) and that current human health exposure pathways are under control (8). Therefore, active control of impacted groundwater migrating off-site beneath the southern property is not technically required to control current conditions in the impacted area. However, EMD is proposing to install a groundwater containment measure at the property boundary in a proactive approach to assure that COC concentrations remain below risk based goals at the property boundary point of compliance. Off-site remediation of groundwater is neither required nor will be performed actively. It is anticipated that off-site groundwater concentrations will be reduced by natural attenuation over time.

Off-site COC concentrations in groundwater are currently below risk reduction goals for this site (7). Evaluation of potential exposure pathways to concentrations in groundwater took into consideration the industrial/commercial land use classification around the site. Potential exposures and risks were evaluated using current and expected exposure scenarios, and using current reasonably anticipated future land use. Maximum contaminant levels (MCLs) are not applicable to the site because the perched groundwater is not a drinking water source (10).

4.3 Ecological Risks

An ecological risk evaluation completed during the RI process determined that the overall potential for long or short term ecological risks at the site or at associated off-site locations was negligible (1). Relatively few flora or fauna were identified due to the industrial nature of the area.

4.4 Summary of Site Risk Under Current Conditions

Potential risks associated with current site conditions are summarized in the *Remedial Investigation* (1), the *Conceptual Model of Current Conditions* (5) and the *HHRA Addendum* (6). These documents supported the completion of the *Groundwater Environmental Indicator* (9) and *Human Health Environmental Indicator* (8), and conclude the following:

- The only human health risks above U.S.EPA risk reductions goals on site are a potential risk for on-site construction worker scenario for contact with soil or water and an indoor air vapor inhalation risk for on-site workers;
- Observed concentrations of COCs that have migrated off-site are at or below risk based levels – therefore, no off-site risks exist under the current and reasonably foreseeable future industrial land use scenario;
- Off-site surface water is not impacted by groundwater containing COCs; and,
- No significant ecological pathways and risks are present at on and off-site locations.

5.0 Evaluation of Alternatives

As part of the final remedy identification and proposal development, several remedial technologies and actions have been evaluated for their ability to meet CAOs for the Cincinnati site. Corrective Measures Study evaluations have focused on four basic alternatives.

- No Action
- In-Situ Treatment
- Source Removal/Excavation
- Containment with Institutional Controls

Of the four options, on-site containment and limited excavation was found to be the most protective of human health and the environment and cost effective solution. This *Draft CMP* provides a brief summary of the evaluation of these four options. Additional detail on remedy feasibility studies can be found in the original *Feasibility Study Report* (2) and the accepted *Feasibility Study* (3) completed by the Ohio EPA.

5.1 Alternative 1 – No Action

A No Action approach would leave waste, impacted soil and groundwater in place, with no containment or exposure controls. This approach results in the following:

- No protection against potential future releases of chemicals at concentrations above site risk based levels from the West Ravine waste that could migrate off-site; and,
- No controls to prevent the unacceptable risk associated with exposure from:
 - any potential future property owner from excavating into the West Ravine waste;
 - controlling on-site risks associated with indoor air; and,
 - excavating into soils/groundwater containing COCs above site risk based levels for construction workers in affected areas outside of the West Ravine.

Natural attenuation processes would continue; however there would be no means to verify or monitor its progress.

The No Action option does not provide the level of protection for human health and the environment that USEPA and EMD have incorporated into the site's CAOs. Therefore, EMD does not consider the "No Action" alternative to be a viable final remedy.

5.2 Alternative 2 – In Situ Treatment

The in-situ treatments such as soil flushing, bioventing, and hydraulic fracturing were removed from consideration during the screening process because any one treatment cannot address all contaminants of concern and/or would be ineffective due to the physical nature of subsurface geology at the site. This approach would result in the following:

- require multiple technologies to address all chemicals of concern that could not be implemented concurrently;
- inconsistent response from pumping or vapor extraction due to low permeability and heterogeneous nature of the site geology;
- inability of vapor extraction to extract all COCs (i.e. 1,4-dioxane); and,
- would not address buried waste material;

Further discussions related to selection criteria are presented in the original *Feasibility Study Report* (2). To summarize, in-situ options do not meet all CAOs for the site, therefore this option was not forwarded for consideration.

5.3 Alternative 3 – Source Removal/Excavation

Though West Ravine buried waste is currently stable, source removal would prevent the potential for unacceptable exposure to hazardous materials and future releases to soils/groundwater. Source removal would require an excavation alternative as follows:

- Excavation of West Ravine waste, stabilization, and transportation to an incineration facility for destruction;
- Excavation of soils driving on-site risks; and,
- Monitoring groundwater to assure risk reduction goals associated with both the construction worker and indoor air exposure pathways.

While removal of waste/soils appears to be a good way to manage and reduce risks, this approach has the following issues:

- Excavation and stabilization of waste during construction present an exposure risk that does not currently exist. Removal and transportation activities could result in unacceptable releases of COCs to human health and the environment, especially due to the mixing of unknown chemicals currently contained in various glass containers included in the West Ravine waste;
- Excavation will likely not address the entire volume of soil or groundwater driving on-site risks due to the logistics of excavating to the depth necessary on an active facility; and,
- Even limited excavation of waste will result in an entire shut-down of EMD's facility operations for possibly months.

Further, many of the issues identified above also make this a cost prohibitive option. Excavation of the mouth of the West Ravine up to the middle of the West Ravine (under EMD facilities) were assessed in the Ohio EPA *Feasibility Study* (3), amounting to **\$15 million**. Additionally, based on a listed waste designation for the excavated soil and waste, these materials would need to be destroyed via incineration, which would amount to \$150 million in this scenario. The incremental level of protection provided by this option does not justify the huge difference in cost between this and the containment option described below.

5.4 Containment with Institutional Controls

The final set of remedial options evaluated focused on engineering controls to provide containment of waste in the West Ravine (which is currently stable), and institutional controls to prevent exposure. This alternative is protective of human health and the environment (See **Sections 6** and **7** for details) and provides the following benefits:

- On-site containment of identified environmental risks;
- West Ravine waste is maintained in its current stable condition;
- Infiltration of surface water into West Ravine waste is controlled by the cover and storm water management system;
- Any potential future releases of COCs in groundwater from West Ravine wastes would be hydraulically contained thus preventing off-site migration of COCs;
- Capture of groundwater migrating through on-site contaminated soil to continue to assure concentrations of COCs in off-site groundwater remains below risk-based levels and allowing natural attenuation to continue to decrease COC concentrations over time;
- Mass removal of contaminants via groundwater interception and tank basin area remediation;
- No intrusive excavation of waste from the West Ravine during construction that could result in releases that could impact human health and the environment;
- Long term groundwater monitoring at the point of compliance, ensuring the efficacy of the containment; and,
- Institutional controls that will run concurrent with the land to maintain protectiveness into the future.

For the reasons stated above, this option provides the optimum level of protectiveness for human health and the environment during construction and during operation.

The costs to install and operate this remedy are currently under evaluation, and only a very rough estimate can be provided at this time. Considerations must be made in regards to construction activities inside the mouth of the wooded West Ravine, and in not encroaching upon the ODOT/Norfolk Southern Railroad right of way. Initial estimates for construction of this corrective measure are \$6.5 million, with approximately \$50,000 a year in annual monitoring costs.

6.0 Scope of Corrective Measures

The components of the proposed corrective measure are described below.

6.1 Corrective Action Objectives

The corrective action objectives discussed with, and agreed to by U.S.EPA on March 10, 2006 are:

- Maintain protective conditions;
- Implement safe, technically and economically feasible corrective measures;
- Effective and sustainable long-term operation, maintenance and monitoring;
- Reduce environmental liability; and,
- Minimal disruption of facility operations.

The CAOs will be met by the following corrective measures:

- Removal of off-site waste and consolidation with on-site waste
- Containment and management of on-site waste in-place
- Containment of contaminated groundwater
- Institutional controls

6.2 Components of the Corrective Measure

The CAOs described above will be achieved through implementation of the following corrective measure components:

- Groundwater collection trench and low permeability containment wall along the southern property boundary to intercept potential releases from West Ravine contained waste and groundwater containing the highest concentrations of COCs thus preventing off-site migration of COCs above risk-based levels; this will include the removal of the existing off-site Sump-562 and replacing it with a new on-site upgraded sump located in the trench;
- Off-site waste (debris) will be removed and incorporated into the containment system;
- Continued operation of the existing French Drain collection system to prevent COCs in groundwater from migrating to the eastern property boundary;
- New surface cover and storm water management system over the entire known aerial extent of the buried waste in the ravine to reduce surface water infiltration into the West Ravine; and,
- Institutional and engineering controls to eliminate potential and future on-site human health exposure pathways.

As previously noted, the existing French Drain and (as a backup system) the Recovery Well P6A, interim measures will become an integral part of the proposed remedy and the containment strategy. Additionally, components of the facility modernization plan will be included into the overall corrective measures as part of the ravine cover system described above.

In addition to the proposed containment components of the remedy, EMD has elected to perform the following enhancements (not considered a necessary component of corrective measures) designed to provide contaminant mass removal:

- In-situ remediation of impacted soils located in the former tank farm area; and,
- Limited excavation of impacted soils in the vicinity of the existing off-site sump system.

6.2.1 Containment of Waste/Groundwater

6.2.1.1 Containment of Groundwater Via Collection Trench/Low Permeability Containment Wall

Contaminated groundwater that is migrating towards the southern property boundary will be collected in an interceptor trench to prevent off-site migration of COCs above risk-based goals. Although the groundwater migrating off-site to the southwest does not contain COCs at concentrations above current land use scenario risk based goals, capturing this groundwater will ensure that concentrations of COCs that have already flowed off-site (but are already below current land use scenario risk levels) will be reduced over time through natural attenuation.

The groundwater collection trench will be installed in the area shown in **Figure 6 – Groundwater Collection Trench Map**. The trench will be constructed to the elevation of the bottom of the Lacustrine Unit, and will be filled with permeable drain rock to promote gravity flow to a central sump. From the sump, the impacted groundwater will be pumped back to the EMD facility and will be discharged to the local publicly owned treatment works under the existing permit (to be modified if required).

In addition to a collection trench, a low permeability containment wall will be installed hydraulically downgradient of the collection trench. The wall will provide structural protection for the collection trench, and will provide a secondary benefit of added containment. The wall will extend along the property line, and will be designed such that potential future expansion to the highway alongside the EMD property will not adversely affect the long term integrity of the remedy. This containment wall will be installed prior to the groundwater collection trench for easier construction of the trench and to provide a measure of isolation of construction activities from State Route 562.

Water collected at the French Drain and Sump-562 is currently processed through the existing pre-treatment and pH neutralization system, then discharged to the Publicly Owned Treatment Works (POTW) under EMD's existing permit. As agreed to by the U.S.EPA on March 10, 2006 and in the *Conceptual Agreement of Corrective Measures* (10), groundwater collected by the proposed southern property and new on-site sump will be processed and discharged with the groundwater collected by the French Drain to be carried forward as part of the final remedy. EMD's existing permit with the POTW will be modified as required.

6.2.1.2 Containment of Groundwater Via French Drain/Well P6a System

The existing French Drain groundwater collection system will continue to operate to prevent impacted groundwater from migrating to the eastern property boundary. This system captures groundwater in the Upper Sand Unit located beneath the central portion of the property. Recovery Well P6a will be retained as a backup to the French Drain system.

6.2.1.3 Containment of Waste Via Ravine Cover / Storm Water Management System

Though current calculations indicate very low hydraulic conductivities in the range of $10\text{E-}9$ to $10\text{E-}6$ centimeters/second for the lacustrine unit (the highest permeable and impacted depositional unit at the base of the West Ravine), EMD has chosen to virtually eliminate the amount of surface water that could potentially infiltrate to the mouth of the West Ravine as an enhancement to the containment process. EMD will accomplish this by filling the remainder of the West Ravine up to grade and covering the area with low permeability cover. The containment wall will be extended to the EMD facility elevation (approximately 606 feet mean sea level) and engineered fill and excavated soil from the collection trench construction will be placed in the containment area of the West Ravine. The fill material will be leveled, and the low permeability cover system will be installed over the fill. This cover system will be extended to cover the existing filled portion of the West Ravine area as shown on **Figure 7 (Proposed Areal Extent of New Surface Cover)**. A generalized cross-sectional schematic of the cover system is shown on **Figure 8 (Conceptual Cross Sectional Schematic of West Ravine Cover System)**. Reconsolidated site soils and compactable fill from an external source will be used to bring the mouth of the West Ravine to the same elevation as that of the surrounding site. All fill material will be compacted in lifts. The thickness of concrete and aggregate base installed on top of the compacted fill will be sufficient to allow for truck traffic and storage. No buildings (with the possible exception of non-occupied equipment/material storage shelters) will be constructed over known waste depositional areas of the West Ravine with the current plan for the area to serve as a parking and staging area for the facility. The cover system will serve to virtually eliminate the amount of surface water that would otherwise infiltrate and could come into contact with the buried waste material, and to prevent accidental dermal exposure with impacted soils.

As part of facility modernization and the proposed corrective measures, storm water will be managed through an upgrade of the existing system to be compatible with the new surface cover system. This system will aid the surface cover system in preventing storm water from ultimately leaching into West Ravine waste. Storm water will be captured and diverted away from the West Ravine area through conveyance piping that will ultimately deliver the storm water to Duck Creek.

6.2.2 Removal of Off-Site Waste

During construction activities, visible and accessible wastes associated with on-site activities will be removed from off-site construction areas. This waste is thought to include concrete demolition debris. Additionally, this waste could include broken or whole bottles of off-spec chemicals that were historically buried in the West Ravine. However, a review of investigations

and historical information indicates that this is unlikely or if this type of waste exists, it is very minimal. This waste will be placed into the West Ravine to be managed in place within the containment system.

6.2.3 Vapor Controls through Institutional and Engineering Controls

Institutional and engineering controls are proposed to manage the potential on-site indoor air exposure pathway identified in the *HHRA Addendum* (6). The potential excavation exposure pathways will be addressed on-site through currently practiced facility guidelines and physical indoor air management.

EMD will create and utilize documented facility guidelines and health and safety plans to ensure that all staff and subcontractors adhere to the site-specific health and safety plan. The 24-hour surveillance and fencing of the facility prevents unauthorized and uninformed personnel from accessing the site and circumventing these controls. Current normal operating procedures and industrial hygiene practices in conjunction with adequate indoor air exchange via building ventilation systems will continue to prevent exposure by assuring workers are protected via personal protective equipment (PPE)/operating procedures and air exchange rates are great enough to provide the necessary level of protection against potential vapor intrusion.

A documented facility management plan will be created and remain in place to detail the indoor air quality control procedures.

6.2.4 Institutional Controls

Institutional controls are proposed to manage the potential on-site construction worker exposure pathways identified in the *HHRA Addendum* (6). This potential excavation exposure pathway will be addressed on-site through currently practiced facility guidelines and through the filing of a deed restriction for the property. EMD will create and utilize documented facility guidelines and health and safety plans to ensure that all staff and subcontractors adhere to the site-specific health and safety plan when performing subsurface excavation work. The 24-hour surveillance and fencing of the facility prevents unauthorized and uninformed personnel from accessing the site and circumventing these controls.

These procedures will be a part of the documented facility management plan that will detail the subsurface work restrictions.

A land use restriction limiting the land to industrial uses only will be enacted through a deed restriction and be carried with the property through all land ownership transfers (run concurrent with the land). The deed restriction will serve to deter the following:

- Residential or recreational use of the property;
- Subsurface excavations without proper controls and PPE;
- Potable use of perched groundwater; and,
- Construction of buildings without proper engineering and institutional controls.

6.2.5 Remedy Enhancement – Tank Farm Remedy

To enhance the containment element of the final remedy, EMD is proposing to perform additional measures to reduce the soil and groundwater concentrations in the former tank farm area, thereby reducing the source of long-term groundwater contamination. Although this remedy is not necessary for the remaining components of corrective measures to be successful since groundwater from this area is captured by the collection trench, reducing the source of contamination may reduce duration over which the trench system is needed.

Based on existing data, the approximate aerial extent of total VOCs in fill soils in the former tank farm area and the approximate vertical extent have been interpreted as shown on **Figure 9 – Total VOC Concentrations in Former Tank Farm Area** and further described in the CMCC (5). VOC contaminants in soil consist primarily of 1,4-dioxane, chlorinated hydrocarbons, and lower concentrations of benzene (1).

Source reduction is the goal of the tank farm remedy enhancement. Initially, the remedy enhancement will likely consist of an in-situ treatment to address soil and groundwater containing 1,4-dioxane. Additional in-situ technologies may be subsequently applied to target reduction of CVOC concentrations that are sorbed to soil particles. Treatment options are being developed and will be implemented during or following installation of the proposed corrective measures presented herein.

6.2.6 Remedy Enhancement - Limited Excavation of Off-Site Soils

As previously discussed, Sump 562 will be removed during construction of the interim measures. As part of the removal, EMD has elected to perform additional source removal of soils around Sump 562 identified as being impacted based on visual screening and field instruments (e.g. photo ionization detector) will be removed to the extent practical. Such excavated soils will be limited by physical barriers such as the adjacent railroad bridge and highway. As agreed to in the *Conceptual Agreement for Corrective Measures* (10), no confirmation soil sampling is required nor will be completed as a result of the excavation of off-site debris or impacted soils.

6.3 Performance Standards

Performance Standards for containment agreed to by U.S.EPA and EMD during the March 10, 2006 meeting are:

On-Site Performance Standards

- Effectiveness of containment (waste and contaminated groundwater) will be demonstrated through the following observations:
 - Stable surface conditions maintained in areas indicative of subsidence.
 - Concentration levels of contaminants in groundwater do not increase and will likely decrease.

- Effectiveness of engineering controls demonstrated through inspection of the following:
 - Site cover integrity monitored for cracks (structures) or erosion (soil cover).
 - Site fencing effectiveness as an access control.
- Demonstration that appropriate institutional controls are in place:
 - Deed restriction to industrial land use is filed.
 - Site operational practices and controls implemented to protect workers.

Off-Site Performance Standards

- Visible and accessible wastes associated with on-site activities (consisting of concrete demolition debris, broken or whole bottles containing off-spec chemicals) will be removed.
- Off-site soils in the vicinity of the existing off-site sump system identified as being impacted through visual or screening level observations (e.g. photo ionization detector) will be removed to the extent practical during construction. Excavations will be limited to physical restraints (road, railroad bridge, etc.). Confirmatory soil sampling will not be necessary or conducted.
- Cleanup standards for off-site groundwater will be risk-based levels for COCs associated with EMD facility:
 - Standards to be calculated based on appropriate and currently identified exposure scenarios for current and reasonably anticipated future land use (a construction worker entering an excavation in the affected area of the transportation corridor).
 - MCLs are not applicable because perched groundwater is not a drinking water source and therefore ingestion is not a relevant exposure pathway.
- Point of compliance is the property boundary.

6.4 Performance Monitoring

The general monitoring program envisioned to demonstrate that Performance Standards will be met by the proposed corrective measures will consist of following elements:

6.4.1 Containment

Performance monitoring for containment will consist of the following:

- Engineering controls installed to virtually eliminate surface water infiltration into the waste and aid in the prevention of direct contact with contaminated soils will be demonstrated through visual monitoring for cracks in surface cover or buildings, subsurface subsidence, and visual monitoring for soil erosion;
- Groundwater level monitoring demonstrating hydraulic containment at the point of compliance through potentiometric surface mapping; and,

- Monitoring of effluent from the hydraulic containment trench will be performed to determine if releases of chemicals from the West Ravine waste are occurring due to a spike in VOC concentrations.

Risk reduction goals (as discussed in **Section 4**) will be used as *CMP* performance standards at the property boundary point of compliance (defined as the southern property boundary from the western extent of EMD property to the NS railroad bridge; and the eastern property boundary from the northeast property corner to the NS railroad bridge). MCLs are not applicable because groundwater is not used as drinking water. Therefore, risk reduction goals have been met for off-site groundwater and the demonstration of hydraulic containment will suffice as the demonstration of continuing to meet risk reduction goals during operation of corrective measures.

Containment will be confirmed through groundwater level monitoring of the monitoring wells utilized in the pre-remedy installation quarterly groundwater sampling events (**Table 2 - Performance Monitoring Well Schedule**). During the first year of this proposed monitoring, water levels will be gauged on a quarterly basis to demonstrate that hydraulic control is being achieved by the corrective measures and to establish a baseline for groundwater flow with the remedy in place. For four years following this one-year demonstration, the number of monitoring wells and the frequency of gauging will be reduced to a subset that will monitor significant departures from the baseline conditions that could indicate hydraulic capture may not be occurring. The number of wells and frequency of monitoring will be evaluated based on the data and the new monitoring plan will be transmitted to the U.S.EPA. Termination standards for groundwater monitoring will include a consistent demonstration of the system to maintain hydraulic containment for a period of 5 years.

Should water levels indicate that hydraulic control is not being attained, groundwater samples will be collected from a subset of monitoring wells and be analyzed for site COCs. The purpose of the sampling will be to assure that the interpreted lack of hydraulic control in an area of the site is not resulting in COCs migrating off-site at concentrations above site specific risk based levels. Determination of monitor wells to be sampled would be based on an evaluation of the hydraulic data.

Effluent monitoring will begin concurrently with the monitoring well static water level gauging. Effluent monitoring for site COCs will be performed on a monthly basis for the first two years at which time the sampling schedule can be re-evaluated. Concentrations observed in the effluent will be measured against the POTW permit requirements, though not be used for determinations of risk as that will be accomplished through the monitoring well sampling described above.

Visual inspections of applicable remedy components will occur monthly for the first year and quarterly for the next 4 years. At the end of 5 years of monitoring, monitoring frequency will be re-evaluated. Surface inspections will consist of visual observations of the entire surface cover in the area of the remediation system to determine if subsidence, erosion, or significant fractures of the cover are present. Visual inspection of the retaining wall for seeps and the security fence for integrity issues will also be performed.

A complete monitoring plan will be developed and submitted to U.S.EPA after the proposed remedy has been constructed.

6.4.2 Institutional Controls

Institutional controls will include the filing of a deed restriction and documented site operational procedures to protect workers.

A deed restriction that outlines the restrictions placed upon the property will be filed with the Hamilton County Ohio Auditor's Office for placement on the property deed. Once accepted by Hamilton County, a copy of the approved deed restriction will be provided to U.S.EPA.

The facility management plan will be used as an integral part of EMD's health and safety program. The document will be on file at EMD's facility and available for inspection by U.S.EPA upon request.

7.0 Evaluation of Proposed Corrective Measures

This evaluation demonstrates why the proposed remedy is appropriate to address unacceptable risks at the site. The proposed remedy was evaluated against the site-specific corrective action objectives presented in **Section 2.0** and U.S.EPA's remedy selection criteria, as described in the following paragraphs.

7.1 Containment

Effectiveness:

The hydraulic barrier created by installing the groundwater collection trench along the southern property boundary will be effective in intercepting groundwater flowing through waste contained in the West Ravine and on-site soils containing COCs at the southeast portion of the site, near the mouth of the West Ravine. The trench will extend to the bottom of the Lacustrine Unit. By creating a layer of highly permeable material in the trench, groundwater will naturally migrate into the trench and towards the extraction sump via gravity drain. Groundwater will then be extracted via extraction at the sump. To summarize, the trench will intercept groundwater flow through the Lacustrine, Upper Till, and Fill Units where the trench is present.

Additionally, the low permeability containment wall will serve as a secondary hydraulic barrier. The wall will provide structural protection for the collection trench, and will provide a secondary benefit of added containment. The wall will extend along the property line, and will be designed such that potential future expansion to the highway alongside the EMD property will not adversely affect the long term integrity of the remedy.

Long-term Reliability:

The groundwater collection trench technology has proven reliable in past installations throughout the country. This remedy is anticipated to be reliable over the long-term.

Maintenance of the collection trench may be required in the future and features will be designed into the trench to facilitate periodic maintenance (i.e. flushing of precipitants). Overall reliability will partially depend on consistent operation and maintenance of the collection system, particularly the operation of the pumps to maintain an inward gradient to the trench.

Constructability:

The groundwater collection trench will be constructed using an appropriate construction method. The construction method will be chosen to install the trench to the depth and width required for this site considering the topography, hydrogeology and performance goals. Site visits by construction contractors have provided viable options towards completing this trench.

The containment wall construction method is currently being finalized. However, methods considered constructible in this situation have been identified.

Implementation Risk:

Risks associated with the implementation of the collection trench are primarily associated with the excavated material. This material may contain VOCs and off-specification chemicals that were disposed in the ravine in the past. Exposure to workers will be minimized through the use of personal protective equipment. During construction, vapor exposure will be limited by engineering control, including using the fill material that will be placed on top of the West

Ravine waste to decrease grade/allow equipment access, and any additional vapor control measures deemed necessary. Should conditions deteriorate so that the initial engineering controls are not adequate, secondary methods will be employed. Details regarding the construction methods and safety procedures will be given in the construction report following corrective measures construction. Additionally, the containment wall will provide a measure of isolation from the nearby State Route 562.

7.2 Ravine Cover System

Effectiveness:

The engineered fill to be placed in the ravine will be semi-angular such that it promotes drainage of any water migrating through West Ravine waste and out of the current face of the West Ravine to the groundwater collection trench, can be compacted to minimize settling, and provide an appropriate sub-grade for the low permeability cover. The low permeability cover will act as a barrier to surface water and direct site storm water via gravity to the catch basins. The cover will be gently sloped downward from the top of the containment wall to the storm water catch basins. The cover system is expected to effectively keep the majority of surface waters from contacting buried waste material or migrating off-site. The low permeability cover system will act as a vapor barrier and minimize the potential for vapor migration from the former ravine. No waste will be visible or accessible once the cover is in place.

Long-term Reliability:

Aside from routine re-surfacing, the cover system will require little or no maintenance, and is expected to be highly reliable in the long-term. The integrity of the cover system will be demonstrated through periodic monitoring for cracks or erosion. Monitoring is recommended as monthly for the first year and then quarterly for the next four years, the frequency of monitoring then being open for revision. Any maintenance required will be performed by EMD and will also be a requirement in the deed restriction that will run concurrently with the land.

Constructability:

The engineered fill placed in the ravine and the associated low permeability cover system is readily available from local vendors. The containment wall will be appropriately designed to support the volume of backfill to be placed against it. Numerous similar cover systems have been successfully constructed in the past.

Implementation Risk:

Implementation risks associated with the low permeability cover system are low. Construction methods and safety procedures are routine and well-established.

7.3 Tank Farm Remedy

Effectiveness:

An in-situ technology will be implemented in the former tank farm area. This remedy is expected to be effective when compared to other remedial technologies in reducing the source area COC concentration. Though the groundwater collection trench principally addresses the West Ravine, it may be possible to design this additional in-situ measure at the former tank farm area to work in conjunction with the trench.

Long-term Reliability:

The tank farm remedy will be implemented over a period of months to years. It is anticipated to permanently reduce the concentration of COCs in this source area, and therefore will be reliable over the long term.

Constructability:

The in-situ technology is under development, but will be designed to easily integrate with the containment concept.

Implementation Risk:

The in-situ technology is under development, but will be designed to easily integrate with the containment concept.

7.4 Institutional Controls

Effectiveness:

EMD site safety program protocols to eliminate potential exposure of on-site workers to waste/impacted media have proven effective in the past and will continue to be effective. Deed restrictions that will run with the land are anticipated to be an effective control to prevent unprotected exposure to waste/impacted media as a result of subsurface excavations and will also govern the design of any future buildings to be constructed in the affected area of the site.

Long-term Reliability:

The EMD site safety program is reliable and updated regularly. After the installation, site operational practices may need to be modified with controls implemented to protect workers and subcontractors. The long term reliability of the program will be ensured by continued education of employees both on- and off-site. The deed restriction will be utilized should the property be transferred to a different owner. The restriction will be recorded in the Hamilton County Platt Book filed to remain with the property through all such transfers, and would be subject to local and state laws.

Constructability:

This evaluation criterion does not apply to the institutional control.

Implementation Risk:

Implementation risks associated with the institutional controls are low. On-site facility practices are self-directed; however, the filing of deed restrictions is subject to local and state laws.

Similar restrictions are filed in these circumstances, and the likelihood of the restriction's denial for this property does not seem likely.

7.5 Performance Monitoring

Effectiveness:

Groundwater monitoring is anticipated to be an effective means for assessing the performance of the remedy components. With concentrations of COCs already below risk based goals at the point of compliance, there is a large safety factor inherent in the performance monitoring. Any indication that hydraulic containment is not being attained will prompt chemical monitoring of groundwater from select monitor wells (collection and analyses of groundwater samples). Concentrations of COCs would be evaluated to determine if the potential for off-site migration of COCs above risk-based goals was occurring.

Hydraulic monitoring and effluent monitoring recommended on a quarterly basis for the first year, and then quarterly for four years after remedy installation with a review of the monitoring plan thereafter. The initial two year time period should allow any dissolved concentrations near the buried waste in the West Ravine to migrate to the point of compliance and to establish a baseline from which to compare performance.

Long-term Reliability:

The long-term reliability of performance monitoring is largely a function of the construction and maintenance of the groundwater monitoring wells. Monitoring wells will be inspected and replaced as needed. The potential replacement of groundwater monitoring wells is not a detriment of the proposed remedy.

Constructability:

The construction of groundwater monitoring wells is routine, though some additional consideration may be needed for the locations the wells are needed. On-site locations for the placement of wells are limited and previous permitting requests with ODOT have been denied. Flexibility in the placement of monitoring wells should be sufficient to address this concern.

Implementation Risk:

Monitoring wells have been installed and used at this site and the adjacent ODOT property for a long time. There is a relatively small risk incurred with installing additional wells.

8.0 Public Participation and Completion

8.1 Mechanisms for Public Participation

All applicable reports have historically been made available to the general public at the Cincinnati Public Library (Norwood Branch) located at 4325 Montgomery Road, Cincinnati, Ohio.

A public meeting was held by Ohio EPA following completion of the RI in 1996.

A notice for a public meeting will be placed into the local newspaper. If public interest warrants, a public meeting will be held to discuss the proposed corrective measures. Input from any public meeting and any formally submitted public comments will be considered by U.S.EPA as part of the remedy selection process and during preparation of the Statement of Basis.

8.2 Corrective Measures Implementation Order

Upon acceptance of the CMP the U.S.EPA will issue a Corrective Measures Implementation Order (CMI) to document the performance standards and requirements associated with implementation and operation of the chosen remedy.

The CMI Order will ensure that the long-term requirements for operation and maintenance of the chosen remedy, including any monitoring and institutional controls, are defined and adhered to until the corrective measures are deemed complete or no longer required.

9.0 References

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